Journal of Contemporary Educational Research, 2025, Volume 9, Issue 5
http://ojs.bbwpublisher.com/index.php/JCER
ISSN Online: 2208-8474
ISSN Print: 2208-8466

Construction of T-Structured Courses in Universities to Cultivate Future Researchers

Jing Wang, Qi Xi*

School of Data Science & Engineering, South China Normal University, Shanwei 516600, Guangdong, China

Author to whom correspondence should be addressed.

Abstract: University courses should have both breadth and depth. However, most courses in universities only focus on the breadth construction, while neglecting the depth construction, resulting in students being unable to apply the knowledge they have learned to conduct research or solve real-world application problems. The students' high-level abilities are insufficient and not well-trained. Therefore, in this paper, we propose a T-structured course design method to ensure both breadth and depth of a course. The proposed T-structured course design method includes four aspects: T-structured course contents, T-structured teaching activities, T-structured examination formats, and T-structured homework difficulty. By applying our proposed T-structured course design strategy to the course Optimization Algorithms and Intelligent Computing, good results are achieved, demonstrating the applicability of our proposed strategy.

Keywords: T-structured course; Course design; Teaching activity; Breadth; Depth

Online publication: June 4, 2025

1. Introduction

In university education, for students to deeply understand the contents of the course and proficiently master the methods introduced in the course, it is necessary to have both "breadth" and "depth" when teachers are designing the course.

"Breadth" refers to the requirement that the content introduced in a course must be comprehensive [1,2], so that students can have a comprehensive and complete understanding of the discipline field the course covers. After knowing the whole picture, students are able to determine the appropriate solutions to solve the encountered problems in their work and study in the future. Without "breadth," although students can proficiently use one or two techniques to solve problems, they will not be able to understand the differences and connections between methods, and will be in a state of partial understanding. Therefore, the breadth of teaching content determines students' perspectives.

"Depth" means that the contents of a course should be learned in a deep way [1]. After studying a course deeply, students should become proficient in a certain technique within the course, in order to achieve the

effect of being able to apply it to solve practical problems skillfully. The depth of a course is one of the major factors influencing the ability of a student to tackle practical problems, i.e., the depth of a course determines its practicality. Only the techniques and methods that students can proficiently apply can be considered truly learned knowledge.

Without "breadth," students will face the embarrassing situation of "seeing only the trees but not the forest." In addition, without "depth," students can only stay at the level of preliminary understanding. Students only know a little bit but are not proficient with the knowledge taught in the course, which will make students' learning superficial and useless, resulting in the inability to apply the knowledge in their future work and research.

However, at present, many courses in universities only have a good design for breadth, while the design of depth is relatively weak. This results in students having learned a lot of knowledge, but their application ability is relatively weak. Due to the lack of in-depth learning, students' learning of knowledge and technology only stays at a superficial level. Students' advanced abilities cannot be cultivated [3], and their advanced abilities are actually the most important abilities required for their future scientific research and innovation.

"Breadth" is like a horizontal line of the letter T, and "depth" is like a vertical line of the letter T, as shown in Figure 1. A truly good course, a course that can benefit students, should be a combination of "breadth" and "depth," i.e., a course with a "T-shaped" structure. Therefore, in this paper, we propose a strategy for building a T-structured course.

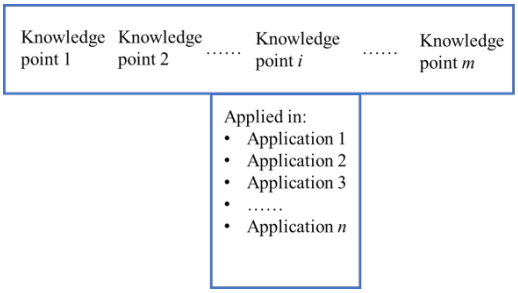

Figure 1. A T-structured course should have both breadth and depth

2. Proposed strategy

Following the idea of designing a T-structured course to consider both breadth and depth of a course, we propose to develop the following T-structured strategies: T-structured contents of a course, T-structured teaching activities, T-structured examination, and T-structured homework difficulty. We take the course Optimization Algorithms and Intelligent Computing as an example.

2.1. T-structured contents

The course Optimization Algorithms and Intelligent Computing mainly introduces four major categories of methods for solving optimization problems. They include the graphical methods, the heuristic methods, the analytical methods, and the numerical methods. Each category of the methods contains many different algorithms, so the content involved is quite extensive. The course has a wide breadth, as shown in **Figure 2**.

Furthermore, except for the breadth of the course, the depth of the course is also considered. Teachers should select one or two specific algorithms to discuss in detail and show different applications of these algorithms. For example, in the Optimization Algorithms and Intelligent Computing course, we select the

widely used algorithm, the genetic algorithm, as the method for "in-depth" teaching. We show students almost all the possible applications of the genetic algorithm. For instance, how genetic algorithm handles the linear programming problems, the integer programming problems, the combinatorial optimization problems, the problems with hard and soft constraints, continuous function optimization problems, artificial intelligence problems, feature selection problems in machine learning, hyperparameter optimization problems in machine learning models, network optimization problems, etc., as shown in **Figure 2**. This in-depth teaching can help students acquire a deep and thorough understanding of the genetic algorithm and help students apply this algorithm in future research.

Teachers can choose any other algorithm for the depth construction. We believe that choosing one or two algorithms for the depth construction is appropriate. Otherwise, there will be too much teaching content for the depth construction, which will affect the breadth construction.

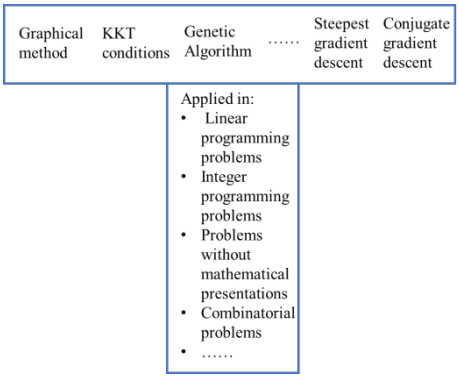

Figure 2. T-structured contents have both breadth and depth

2.2. T-structured teaching activities

Teaching activities need to be constructed in a T-structured format. The teaching of various knowledge points is conducted in the classroom as a means of breadth construction. The deep learning of a certain knowledge point is conducted outside the classroom as a means of depth construction. Students are asked to practice various application scenarios of a certain knowledge point during their time outside class. To monitor the students' in-depth learning, students are required to submit their understandings of the content they have learned on a weekly basis and teachers should give students feedbacks and instructions about their deep learning outside class, as shown in **Figure 3**.

2.3. T-structured examinations

We design the examination as T-structured, as shown in **Figure 4**. As the exams belong to the breadth construction, a closed book exam format is used for each knowledge point. As the exams belong to the depth construction, we adopt the form of course projects and open book exams, such as requiring students to apply a certain algorithm to solve a practical problem, or giving students cutting-edge problems and topics for research.

2.4. T-structured homework difficulty

Students' homework should include challenging problems, and homework problems with an elevating nature can promote students' thinking and application abilities [4]. Therefore, the design of homework difficulty should also be T-structured, but is an inverted T, as shown in **Figure 5**.

For breadth construction, the difficulty level of homework is set to be the moderate level. For depth

construction, challenging problems of high level are adopted. Students are encouraged to do brain storming and discuss their solutions with their classmate in order to solve those challenging problems, since problem-based discussion is an effective way to help solve the problem [5].

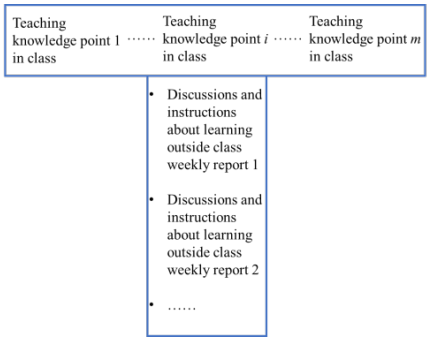

Figure 3. T-structured teaching activities have both breadth and depth

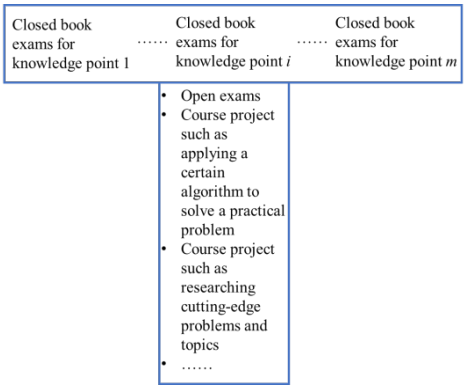

Figure 4. T-structured examinations have both breadth and depth

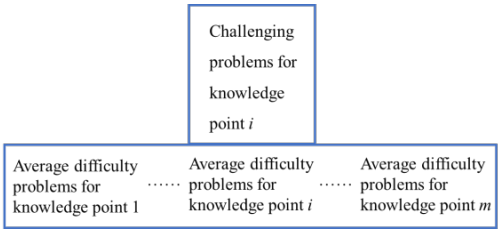

Figure 5. T-structured homework difficulty has both breadth and depth

3. Strategy implementation, results, and conclusions

We apply the proposed T-structured strategy on the course Optimization Algorithms and Intelligent Computing with a teaching class of 45 students. After one semester of implementation, 5 papers [6-10] have been published, including 4 conference papers and 1 SCI journal paper. The first authors are all undergraduate students. This result indicates that the proposed T-structured strategy is feasible and effective.

In conclusion, this paper proposes a T-structured course design strategy to improve the "breadth" and "depth" of university courses from four aspects: T-structured course contents, T-structured teaching activities, T-structured examination formats, and T-structured homework difficulty. While ensuring the "breadth" of the course, efforts are made to enhance the "depth" of the course, helping students have a broad understanding of the course content and high practical hands-on ability, thus improving the classroom teaching effectiveness of undergraduate courses.

Funding

This paper is the implementation results of the Higher Education Teaching Research and Reform Projects of South China Normal University, titled "Construct a T-Structured Course" and "Application of Open Source Drone Platform in Practical Teaching of Internet of Things," and is supported in part by the fund of 2023 Guangdong Province Science and Technology Innovation Strategy Special Project "Construction of Industrial Data and Intelligent Application Innovation Platform" (2023A011), 2024 Shanwei New Generation Electronic Information Industry Talent Revitalization Plan, and the project "Research on the Impact and Countermeasures of Large Scale Charging Facility Access on Guangdong Power Grid Planning and Construction."

Disclosure statement

The authors declare no conflict of interest.

References

[1] Dempster ER, 2024, A Comparative Study of Breadth and Depth of Content in Junior Secondary Biology Syllabi in Four Jurisdictions. International Journal of Science Education, 46(18): 1899–1921.

[2] Perry J, 2024, Depth through Breadth: Teaching Tomorrow's Researchers. Modern British History, 35(1): 66–70.

[3] Li G, 2024, Exploration of Quality Issues and Countermeasures in Undergraduate Teaching in Chinese Universities: Based on the Perspective of Students' Perceived Experience. Education and Culture Forum, 16(04): 98–108.

[4] Huang P, 2023, Analysis and Improvement Exploration of Teaching Problems in Undergraduate "Computational Methods" Course under the "Golden Course" Standard. New Curriculum Research, 2: 21–23.

[5] Tang B, Gong Y, Cen W, 2022, Cultivation of Undergraduate Students' Creative Thinking Ability Based on Problem-Based Teaching Method: Practice from Two Teaching Classes of "Logistics Finance" Course. Logistics Technology, 41(11): 134–138.

[6] Ouyang W, Xu W, Wang J, et al., 2024, A Dynamic Path Planning Method Considering Sea Area Division for Offshore Wind Farm Maintenance, 2024 5th International Conference on Big Data, Artificial Intelligence and Internet of Things Engineering (ICBAIE 2024), Shenzhen, China.

[7] Xu W, Min Y, Wang J, et al., 2024, Offshore Wind Farm Maintenance Scheduling with Integrated Genetic Algorithm Model, 2024 4th International Conference on New Energy and Power Engineering, Guangzhou, China.

[8] Gu S, Wang J, Xi Q, et al., 2024, A Two-Stage Self-Adaptive Method for Designing Optimal Neural Networks for Various Time Series Datasets, 2024 11th International Forum on Electrical Engineering and Automation (IFEEA 2024), Shenzhen, China.

[9] Gu S, Xi Q, Wang J, et al., 2024, TCN-GAWO: Genetic Algorithm Enhanced Weight Optimization for Temporal Convolutional Network. Journal of Mechanical Design, 146(10): 101703.

[10] Deng J, Wang D, Gu J, et al., 2025, SGO: An Innovative Oversampling Approach for Imbalanced Datasets Using SVM and Genetic Algorithms. Information Sciences, 690: 121584.